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Pattern of Lipid Profile of Type 2 Diabetes Patients in Tertiary Hospital South-West Region of Cameroon

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Abstract

Diabetes mellitus (DM) is recognized as a serious global health problem and frequently associated with disabling and life-threatening complications related to some modifiable risk factors. One of the modifiable factors is dyslipidemia. Because detection and treatment of dyslipidemia is one means of reducing cardiovascular disease (CVD) risk, determination of serum lipid levels in people with diabetes is now considered a standard of care. Lipid profile and fasting blood sugar (FBS) of 108 diabetic subjects were assessed. Dyslipidaemia was defined using the national cholesterol education programme–adult treatment panel III (NCEP-ATP III) criteria. BMI and waist circumferences were measured. The mean of the body mass index was 29.85 ± 6.32 kg/m^2 with the males having 27. 23 ± 5.29 kg/m^2 while the females had 30. 90 ± 6.43 kg/m^2. The mean duration of DM was 57.80 ±13.72 month for males while for females it was 6.58 ± 7.11 month. Also 23(74.19%) of the male patients had a waist circumference ≥ 120 cm and 8(25.81%) had a waist circumference <120 cm while for female patients, 64(83.12%) had waist circumference ≥ 88 cm and 13(16.88%) had a waist circumference <88 cm. The mean TC (4.77 ± 1.13 *vs* 5.13 ± 1.24 P=0.1711) and LDL-C (2.79 ± 0.95 *vs* 2.98 ± 1.25 P=0.4016) were slightly higher among the female subjects but the differences were not significant from males, while HDL-C (1.53 ± 0.50 *vs* 1.40 ± 0.42 P=0.2006) and TG (1.35 ± 0.66 *vs* 0.61 ± 0.18 P=0.3424) were higher among the male subjects but were not statistically different from the females. Ninety-eight diabetic patients had at-least one lipid value or the other outside of the clinical target giving it a prevalence of 88.89%. The most frequent lipid combination was ↑TC+↑LDLc. There was no significant correlations between the anthropometric indices and the lipid profile. It is important to realise that hyperlipidaemia and the resultant macro vascular disease can develop even in the 'prediabetic phase' of type 2 DM. Hence, early detection and correction of dyslipidaemic state is essential in the management of diabetic patients.

Keywords: Lipid; Profile; Diabetes; Cholesterol; Anthropometric indices

Introduction

Diabetes Mellitus (DM) is a group of metabolic diseases characterized by increased blood glucose levels, resulting from defects in insulin secretion, insulin action, or both [1]. Glucose is an important regulator of various pancreatic β-cell processes, including insulin biosynthesis and release. Glucose, over short intervals, stimulates insulin biosynthesis at the level of translation. Glucose thus becomes the final common pathway for the transport of almost all carbohydrates to tissue cells. Normally, rates of glucose influx into the circulation and those of glucose efflux out of the circulation into tissues other than the brain are coordinately regulated largely by the plasma glucose lowering hormone, insulin, and the plasma glucose raising hormones, glucagon and epinephrine. Thus systemic glucose balance is maintained, hypoglycemia as well as hyperglycemia is prevented, and a continuous supply of glucose to the brain is ensured. Several previous studies have attempted to correlate blood glucose levels with serum lipid profile parameters [2,3]. Research findings show that mainly body fat is responsible for increase in prevalence of this disease among the body composition components [4-6]. As early as 1988, it was described as a multifactorial metabolic abnormality consisting of insulin resistance with compensatory hyperinsulinaemia, type 2 diabetes mellitus (T2DM), essential hypertension and hypercholesterolemia [7,8]. Today, however, the World Health Organization (WHO), American Diabetes Association (ADA) and International Diabetes Federation (IDF) use the term "Metabolic Syndrome" to describe this clustering of conditions [9]. The term

diabetic dyslipidemia comprises a triad of raised triglycerides, reduced high density lipoprotein (HDL) and excess of small, dense low density lipoprotein (LDL) particles. The lipid abnormalities are prevalent in diabetes mellitus because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism [10]. Micro- vascular and macro-vascular complications, including cardiovascular disease (CVD), retinopathy, nephropathy, and neuropathy, occur due to chronic uncontrolled hyperglycemia in diabetics [11,12]. It has been proposed that the composition of lipid particles in diabetic dyslipidemia is more atherogenic than other types of dyslipidemia [13]. The causal association between atherosclerosis and dyslipidemia is well established. In diabetes the associated hyperglycemia, obesity and insulin changes highly accelerate the progression to atherosclerosis [14,15]. In a recent study, it was observed significant trends for rising risk of coronary heart disease, stroke and all-cause mortality in relation to higher levels of baseline HbA1c in more than 11,000 participants in the Atherosclerosis Risk in Communities Study. For HbA1c categories of <6.5% and ≥ 6.5%, there was a significant association between fasting blood glucose levels and coronary heart disease, stroke or death from any cause [16]. It was attempted to correlate blood glucose levels with serum lipid profile parameters in previous studies [2] and it is clear that HbA1c values are lower in individuals with a decreased risk of micro-vascular complications [16].

In the present study, we aimed to research association between serum lipid profiles among diabetes patients attending the investigative department of Buea Regional Hospital.

Materials and Methods

This cross sectional study was carried out on consented 108 already diagnosed adult type 2 diabetic patients attending the outpatient department of Regional Hospital and Diabetic care education Center, Buea, South-West Region of Cameroon from October to December 2017. Patients who were on lipid lowering medications were excluded. After an overnight fast, blood samples were collected for lipid profile (which includes Triglycerides (TG)], Total Cholesterol (TC), high density lipoprotein C (HDL-C), low density lipoprotein C (LDL-C) and very-low density lipoprotein-C (VLDL-C). The TG was determined using the enzymatic method (Esders and Michira, 1997) [17], the total cholesterol was determined using the enzymatic method [18], HDL-C was determined using the precipitation method [19] and LDL Cholesterol (LDL-C) was determined from the Freidwald's formula: LDL-C=TC-(HDL-C+TG/5). These tests were measured using an automate.

The plasma sugar was determined using the glucose oxidase enzymatic method [20]. Dyslipidaemia was defined using the National Cholesterol Education Programmed–Adult Treatment Panel III (NCEP-ATP III) [21] criteria as follows: Total Cholesterol>5.2 mmol/l, LDL-C>3.4 mmol/l, HDL-C<1.03 mmol/l for males, <1.3 mmol/l for females and Triglyceride>2.3 mmol/l. Blood pressure was measured on left arm by auscultatory method using a mercury sphygmomanometer. The individuals were made comfortable and seated at least for five to ten minutes on a chair before measurement. Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg as per US seventh joint national committee on detection, evaluation and treatment of hypertension (JNC VII) criteria [22].

Body weight was measured (to the nearest 0.1 kg) with the subject standing motionless on the bathroom weighing scale [23].

Each weighing scale was standardized every day with a weight of 50 kg. Height was measured (to the nearest 0.1 cm with the subject standing in an erect position against a vertical scale of portable stadiometer and with the head positioned so that the top of the external auditory meatus was in level with the inferior margin of the bony orbit. BMI was calculated as weight in kilograms divided by squared height in meters. Conventional BMI cut off points were applied to classify the study populations into underweight (BMI<18.5 kg/m^2), normal BMI (18.5 ≥ BMI<25 kg/m^2) and overweight (BMI ≥ 25 kg/m^2).

Waist and hip circumferences were measured twice to the nearest centimeter using a non-stretchable measuring tape and the mean values were used for subsequent analysis. Waist circumference (WC) was measured half way between the lowest rib and the iliac crest with the subject standing at end of gentle inspiration, while Hip Circumference (HC) was measured at the level of the greater trochanters. The waist hip ratio (WHR) and the waist to height ratio (WHtR) were then computed for each patient. Elevated WC was defined as WC=102 cm for men and 88 cm for women [24], while elevated WHR was defined as WHR=0.95 for men and 0.88 for women [25].

Ethical clearance for this study was obtained from the Ethics Review and Consultancy Committee of the Cameroon Bioethics Initiative [CAMBIN].

The statistical software SPSS (version 20) was used for data analysis. The mean values of WC, HC, BMI, WHR, WHtR and BP were determined. The Mann-Whitney U Test was used to compare between the variables. Statistical significance was taken as $p<0.05$. Correlations between the variables were examined using the Spearman Rho correlation coefficients. Multivariate regression analysis was used to investigate the correlations between the lipid variables and other parameters assessed.

Result

The general characteristics of the population in this study are shown in Table 1. Out of the 108 participants recruited in this study 28.7% (31/108) were males while 71.3% (77/108) were females. The mean age of the participants was 57.49 ± 12.46 years with minimal being 24 years and the maximal 91 years. The mean age of males was 57.80 ± 13.72 years with the minimal being 24years and the maximal 91years while the mean age of the females was 57.18 ± 11.20 years with the minimal being 29 years and the maximal 84years. The mean of the body mass index was 29.85 ± 6.32 kg/m^2 with the males being 27. 23 ± 5.29 kg/m^2 and the females 30.90 ± 6.43 kg/m^2. The mean duration of DM was 57.80 ±13.72 month for males and 6.58 ± 7.11 month for females. Also 23(74.19%) of the male patients had a waist circumference ≥ 120 cm and 8(25.81%) had a waist circumference <120 cm while for female patients, 64(83.12%) had waist circumference ≥ 88 cm and 13 (16.88%) had a waist circumference <88 cm. A total of 15.74(17/108) had a family history of diabetes against 84.26% (91/108). Also 30.56(33/108) had a settled way of life against 69.44% (75/108). A total of 47.23% (51/108) of the participants consumed alcohol against 52.77% (57/108) non-alcoholic consumers. In addition, 68.2 % (74/108) ate rich oil against 31.8% (34/108).

Among all the participants, 20.37%(22/108), 31.48%(34/108), 34.26%(37/108) and 15%(15/108) had no, primary, secondary and higher levels of education while 11.11%(12/108) were single, 64.81(70/108) married, 23.15%(25/108) widow and 0.93%(1/108)

divorce. The clinical and biochemical characteristics of the subjects in this study are shown in Table 2. The mean age, the duration of DM and waist to height ratio were similar in both sexes. The body mass index, and the waist circumference were significantly higher among the female diabetics.

Host characteristic	Male	Female	P-value
	(n=31)	(n=77)	
Age (years)	57.80 ±13.72	57.18 ± 11.20	0.708
Duration of DM (years)	6.01 ± 5.62	6.58 ± 7.11	0.6949
Body mass index (kg/m2)	27.23 ± 5.29	30.09 ± 6 .43	
Obese	33.92 ± 5.72	35.44 ± 4.86	
Overweight	27.10 ± 1.57	26.92 ± 1.53	0.0057
Normal	22.64 ± 1.54	22.70 ± 1.78	
Underweight	18.44 ± 0.03	17.74 ± 0.01	
Waist circumference	≥ 120 cm	≥ 88 cm	
	23(74.19%)	64(83.12%)	
	<120 cm	<88 cm	0
	8 (25.81%)	13 (16.88%)	
Family history of diabetes	5	12	
Yes	-16.13%	-15.58%	
No	26	65	0.1173
	-83.87%	-84.41%	
Settled way of life	12	21	
Yes	-38.71%	-27.27%	
No	19	56	0.1364
	-61.29%	-72.73%	
Marital status			
Single	2 (6.45%)	10 (12.99%)	
Married	28 (90.32%)	42 (54.55%)	
Divorce	0	1 (1.30%)	0.0045
Widow(er)	1 (3.23%)	24 (31.17%)	
Academic level			
None	1 (3.23%)	21 (27.27%)	
Primary	9 (29.03%)	25 (32.47%)	
Secondary	13 (41.94%)	24 (31.17%)	0.0091
University	8 (25.81%)	7 (9.09%)	
Consumption of alcohol			
Yes	19(61.29%)	32(41.56%)	0.0631
No	12(38.71%)	45(58.44%)	
Eating habit			
Foods rich in starch	31(100%)	77(100%)	1
Foods rich in starch	31(100%)	77(100%)	1
Foods rich in fat	24(77.42%)	50(64.93%)	0.2063
Foods rich in Proteins	30(96.77%)	74(96.10%)	0.0278
Eating habits Vegetable	31(100%)	77(100%)	1
Regular Fruit intake	23(74.19%)	62(80.52%)	0.2178

Table 1: General characteristic of the population.

The mean TC (4.77 ± 1.13 *vs.* 5.13 ± 1.24 P=0.1711) and LDL-C (2.79 ± 0.95 *vs* 2.98 ± 1.25 P=0.4016) were slightly higher among the female subjects but the differences were not significant from males, while HDL-C (1.53 ± 0.50 *vs* 1.40 ± 0.42 P=0.2006) and TG (1.35 ± 0.66 *vs* 0.61 ± 0.18 P=0.3424) were higher among the male subjects but were not statistically different from the females.

Host characteristic	**Men (Mean ± SD)**	**Women (Mean ± SD)**	**P-value**
Number of subjects	31	77	
Age (years)	57.80 ± 13.72	57.18 ± 11.20	0,8067
Duration of DM (years)	6.01 ± 5.62	6.58 ± 7.11	0.6949
Body mass index (kg/m2)	27.23 ± 5.29	30.09 ± 6 .43	0.0057
Waist circumference (cm)	96.96 ± 11.68	102.23 ± 14.00	0,0673
Waist height ratio	0.61 ± 0.17	0.65 ± 0.11	0.1258
Total cholesterol (mmol/l)	4.77 ± 1.13	5.13 ± 1.24	0,1711
LDL-C (mmol/l)	2.79 ± 0.95	2.98 ± 1.25	0,4016
HDL-C (mmol/l)	1.53 ± 0.50	1.40 ± 0.42	0,2006
TG (mmol/l)	1.35 ± 0.66	0.61 ± 0.18	0,3424

Table 2: Clinical and biochemical characteristics of the subjects.

Table 3 shows the frequency pattern of lipid profile among type 2 DM with dyslipidemia. Based on the NCEP-ATP III criteria, 96 diabetic patients had at-least one lipid value or the other outside of the clinical target giving it a prevalence of 88.89%. Ten of the subjects had all the four lipid value outside the clinical target giving it a prevalence of 9,25%, with 9,09% of them being females. The most frequent lipid combination was ↑TC+↑LDLc (40.74% in both sexes), followed by TC +↑LDLc (23.14% in both sexes). The sex distribution frequency of the lipids analyte studied among the subjects is shown in Figure 1. Table 4 shows the Spearman's correlation coefficient between the lipid profile and the anthropometric indices. Among the male and female diabetics' patients, there was no statistically significant correlation between the anthropometric indices and the lipid profile. A one-way between

groups multivariate analysis of variance was performed to investigate sex differences in lipid profile. No significant difference was observe between lipid profile and family history of diabetes between males and females except with LDLC where a significant difference was observed between males and females (P=0.01). On the other hand, no significant difference was observed between lipid profile and starch rich meal, lipid rich meal, vegetable diet, fruit intake, alcohol intake and settled way of life. But significant difference was observed between males regarding protein rich meals TG (P=0.00) and settled way of life LDLC (P=0.04) (Table 5).

	Male		Female		Combined	
	Frequency	%	Frequency	%	Frequency	%
TC+HDL+LDLc+TG	5	16,12	7	9,09	12	11,11
↑TC+↓HDL+↑LDLc+↑TG	3	9,677	7	9,09	10	9,25
↑TC+↑LDLc	12	38,70	32	41,55	44	40,74
↑TC+ ↓HDL	3	9,677	18	23,37	21	19,44
TC+↑LDLc	4	12,90	21	27,27	25	23,14
TC+↑TG	3	9,67	13	16,88	16	14,81
↓HDL+↑LDLc+↑TG	3	9,67	6	7,79	9	8,33
↓HDL+↑LDLc	5	16,12	36	46,75	4	3,70
↓HDL+LDLc	4	12,90	12	15,58	16	14,81
↓HDL + ↑TG	4	12,90	17	22,077	21	19,44
↑LDLc+↑TG	6	19,35	14	18,18	20	18,51
TG + ↑LDLc	2	6,45	1	1,29	3	2,77
↑TC only	0	0	1	1,29	1	0,92
↓HDL only	8	25,80	8	10,38	16	14,81
↑LDLc only	1	3,22	1	1,29	2	1,85
↑TG only	1	3,22	3	3,89	4	3,70

Table 3: Distribution of lipid profile among dyslipidaemic type 2DM.

	TC		HDLC		LDLC		TG	
	Male	Female	Male	Female	Male	Female	Male	Female
WC	-0.03	0.11	-0.028	0	-0.064	0.123	0.129	0.052
WHtR	0.169**	0.171	-0.22	-0.004	0.207	0.191	0.296	-0.012
BMI	-0.11	0.151	-0.14	0.046	-0.102	0.145	0.102	0.034
MSP	-0.032	0.131	0.274	0.156	-0.11	0.046	-0.167	0.132
MDP	-0.005	0.095	0.101	0.158	-0.021	0.025	-0.102	0.145
WT	-0.093	0.218	-0.282	-0.037	-0.028	0.234	0.133	0.056

Table 4: Spearman's correlations between lipid profile and anthropometric indices. Waist circumference (WC), waist to height ratio (WHtR), Aterial pressure (AP), Family history of diabetes (FHD), Settled way of life (SWL), Consumption of alcohol (CA), Eating habit (EH), Mean systolic Pressure (MSP), Mean diastolic pressure (MDP), weight (WT) and body mass index (BMI).

	TC	HDLC	LDLC					
	Family History of Diabetes							

	Male		Female		Male	Female	Male	Female	Male	Female
	YES	NO	YES	NO	YES	YES	YES	YES	YES	YES
Normal	2(40.00 %)		9(75.00 %)		2(40.00%)	4(33.33%)	2(40.00%)	4(33.33%)	4(80.00%)	8(66.67%)
Dyslipidemia	3(60.00 %) 5(16.12 %)		3(25.00 %)		3(60.00%)	8(66.67%)	3(60.00%)	8(66.67%)	1(20.00%)	4(33.33%)
Total		26(83.87%)	12(15.58%)	65(84.41%)	5(16.12%)	12(15.58%)	5(16.12%)	12(15.58%)	5(16.12%)	12(15.58%)
P-value	0.07				0.55		0.01			
EH	STARCH RICH MEALS									
	YES		YES		YES	YES	YES	YES	YES	YES
Normal	11(35.48%)		42(54.55%)		19(61.30%)	30(38.96%)	16(51.61%)	24(31.17%)	23(74.19%)	55(71.43%)
Dyslipidemia	31(100.00%)		35(45.45%)		12(38.70%)	47(61.04%)	15(48.38%)	53(68.83%)	8(25.80%)	22(28.57%)
Total	20(64.52%)		77(100.00%)		31(100.00%)	77(100.00%)	31(100.00%)	77(100.00%)	31(100.00%)	77(100.00%)
P-value	1				1					
	LIPID RICH MEALS									
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Normal	16(66.67%	4(57.14 %)	26(52.00%)	16(59.26%)	12(50.00%)	3(42.86 %)	15(30.00%	7(25.93 %)	12(50.00%)	4(57.14 %)	16(32.00%	8(29.63 %)	19(79.17%)	4(57.14 %)	36(72.00%)	19(70.37%)
Dyslipidemia	8(33.33 %)	3(42.85 %)	24(48.00%)	11(40.74%)	12(50.00%)	4(57.14 %)	35(70.00%	20(74.07%)	12(50.00%)	3(42.85 %)	34(68.00%	19(70.37%)	5(20.83 %)	3(42.85 %)	14(28.00%)	8(29.63 %)
Total	24(77.42%	7(22.58 %)	50(64.94%)	27(35.06%)	24(77.42%)	7(22.58 %)	50(64.94%	27(35.06%)	24(77.41%	7(22.58 %)	50(64.93%	27(35.06%)	24(77.41%	7(22.58 %)	50(64.93%)	27(35.06%)
P value	0.62		0.8		p=0.18		p=0.42		0.91		0.87		0.31		0.48	
	PROTEIN RICH MEALS															
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Normal	19(63.33%	1(100.00%)	41(55.41%)	1(33.33 %)	19(63.33%)	0	35(47.29%	2(66.67 %)	15(50.00%)	1(100 %)	23(31.08%	1(33.33 %)	23(76.67%)	1(100.00%)	53(71.62%)	2(66.67 %)
Dyslipidemia	11(36.67%	1(3.23 %)	33(44.59%)	2(66.67 %)	11(36.67%)	1(100.00%)	39(53.70%	1(33.33 %)	15(50.00%)	0	51(68.91%	2(66.67 %)	7(23.33 %)	1(3.23 %)	21(28.37%)	1(33.33 %)
Total	30(96.77%		74(96.10%)	3(3.90 %)	30(96.77%	1(3.23 %)	74(96.10%	3(3.90 %)	30(96.77%)	1(3.23 %)	74(96.10%	3(3.90 %)	30(96.77%	0	74(96.10%)	3(3.90 %)
P-value	0.75		0.75		p=0.22		p=0.83		0.61		0.82		0		0.78	
	VEGETABLE DIET															
	YES		YES		YES	YES	YES	YES	YES	YES						
Normal	20(65.52%)		42(54.55%)		19(61.29%)	30(38.96%)	16(51.61%)	24(31.17%)	23(74.18%)	55(71.42%)						
Dyslipidemia	11(35.48%)		35(45.45%)		12(38.71%)	47(61.04%)	15(48.38%)	53(68.83%)	8(25.80%)	22(28.57%)						
Total	31(100.00%)		77(100%)		31(100.00%)	77(100.00%)	31(100.00%)	77(100.00%)	31(100.00%)	77(100.00%)						
P-value	1								1							

	FRUITS INTAKE															
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Normal	14(70.96%	6(75.00 %)	33(53.23%)	9(60.00 %)	13(56.52%)	2(25.00 %)	22(35.48%	6(40.00 %)	10(43.48%)	6(75.00 %)	18(29.03%	6(40.00 %)	16(69.56%)	7(87.50 %)	46(74.19%)	9(60.00 %)
Dyslipidemia	9(29.03 %)	2(25.00 %)	29(46.77%)	6(40.00 %)	10(43.48%)	6(75.00 %)	40(64.52%	9(60.00 %)	13(56.52%)	2(25.00 %)	44(70.96%	9(60.00 %)	7(30.44 %)	1(12.50 %)	16(25.81%)	6(40.00 %)
Total	23(74.19%)	8(25.80 %)	62(80.51%	15(19.48%)	23(74.19%)	8(25.80 %)	62(80.51%	15(19.48%)	23(74.19%)	8(25.80 %)	62(80.51%	15(19.48%)	23(74.19%	8(25.80 %)	62(80.51%	15(19.48%)
P-value	0.62		0.65		p=0.05		p=0.95		0.23		0.61		0.57		0.14	
P-value	0.62		0.65		p=0.05		p=0.95		0.23		0.61		0.57		0.14	
	Consumption of alcohol															
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Normal	12(63.16%)	8(66.67 %)	18(56.25%)	24(53.33%)	9(47.37 %)	4(33.33 %)	13(40.62%)	24(53.33%)	9(47.37 %)	7(58.33 %)	14(43.75%)	10(22.22%)	12(63.16%)	11(91.67%)	25(78.13%)	30(66.67%)
Dyslipidemia	7(36.83 %)	4(33.33 %)	14(43.75%)	21(46.67%)	10(52.63%)	12(38.71%)	19(59.37%)	21(46.67%)	10(52.63%)	5(41.67 %)	18(56.25%)	35(77.78%)	7(36.84 %)	1(8.33 %)	7(21,87 %)	15(33.37%)
Total	19(61.29%)	12(38.71%)	32(41.56%)	45(58.44%)	19(61.29%)	8(66.67 %)	32(41.56%)	45(58.44%)	19(61.29%)	12(38.71%)	32(41.56%)	45(58.44%)	19(61.29%)	12(38.71%)	32(41.56%)	45(58.44%)
P-value	0.49		0.88		p=0.52		p=0.64		0.77		0.12		0.2		P=0.37	
	Settled way of life															
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Normal	8(66.67 %)	12(63.16%)	21(50.00%)	21(60.00%)	7(58.33 %)	12(63.16%)	17(40.47%)	16(45.72%)	6(50.00 %)	10(52.63%)	10(23.81%)	14(40.00%)	8(66.67 %)	15(78.95%)	30(71.43%)	25(74.43%)
Dyslipidaemia	4(33.33 %)	7(36.84 %)	21(50.00%)	14(40.00%)	5(41.67 %)	7(36.84 %)	25(59.52%)	26(54.28%)	6(50.00 %)	9(47.37 %)	32(76.19%)	21(60.00%)	4(33.33 %)	5(21.05 %)	12(28.57%)	10(28.57%)
Total	12(38.71%)	19(61.29%)	42(54.55%)	35(45.45%)	12(38.71%)	19(61.29%)	42(54.55%)	35(45.45%)	12(38.71%)	19(61.29%)	42(54.55%)	35(45.45%)	12(38.71%)	19(61.29%)	42(54.55%)	35(45.45%)
P-value	0.07		0.65		p=0.08		p=0.14		0.04		0.21		0.41		0.92	

Table 5: Distribution of lipid profile among socio-demographic characteristics.

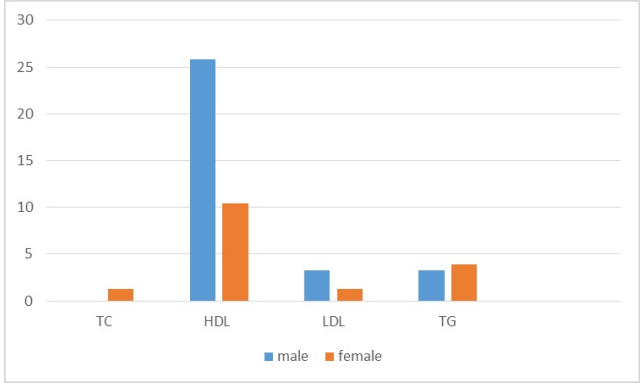

Figure 1: Frequency distribution of lipid profile among the dyslipidaemic diabetes.

Discussion

This was a cross sectional study carried out among 108 diagnosed adult type 2 diabetic patients. Patients who were on lipid lowering medications were excluded from the study. The mean age of the participants was 57.49 ± 12.46 years with minimal being 24 years and the maximal 91 years. The mean age of males was 57.80 ± 13.72 years with the minimal being 24years and the maximal 91years while the mean age of the females was 57.18 ± 11.20 years with the minimal being 29 years and the maximal 84years. The study included higher proportion of females 71.3% (77/108) than males. This result corroborate with the result obtained in a cross-sectional study conducted in Turkey [26]. The high proportion of females in this study may be due to the fact that data were collected at working hours which might be the reason for presence of high proportion of females in the study place and also because most of them were housewives. But in a study done by Sergio et al., it was found that diabetic males/females ratio was less than 1 [27]. The body mass index, the waist circumference, the marital status and academic level were significantly

different between the males and females. These can be justified by the settled way of life and the eating habit that is different between the males and the females. But the significant difference observed in the level of education between the males and the females may be due to the selection of study site but also, in our society the proportion of males schooling are higher compared to the proportion of females. In this study TC, TG, LDL and HDL data were analyzed. A study done by Arora et al. showed that abnormal lipid profile is common in diabetic patients and is an important predictor for metabolic disturbance [28]. Therefore one of the important target for diabetes management is to keep lipid profile within normal limits. A study done in India by Smith and Lall reveals that diabetic males have significantly higher cholesterol levels [29]. But in this study, the influence of sex on lipid profile was not statistically significant. No significant difference was seen in the clinical and the Biochemical characteristics between male and female patients except with the body mass index where a significant difference was observed (P=0.0057). Among all the participants, dyslipidaemia was found to be 88.89%. Such results were obtained by a study done in Lagos by Ogbera et al. [30]. This high level of dyslipidaemia may be justified by the urbanization in the population of the study. Increasing urbanization has been observed to be associated with modernization of lifestyle, which is largely characterised by physical inactivity, change in dietary pattern and consequently, development of obesity [31]. About 40.74% of the subjects had lipid value outside of the target value, the most frequent combination being ↑TC+↑LDLc. This result is similar to that of Kayode et al. [32] and Cook et al. [33] where about 32% and 54% of the subjects had two-lipid values outside of the target value. In this study, we found that a reduced level of HDL had the most frequent lipid abnormality. This result is similar to that obtained by Okafor et al. [32]. We also found elevated LDL-C and TG being the most frequent lipid abnormality among diabetic patients. This result is similar to the result obtained in Lagos also by Ogbera et al. [30]. Of the diabetic patients, 0.92%, 1.85% and 3.70% had elevated level of TC, LDLc and TG only respectively above targeted goal. This result is different from the result obtained by Kayode et al., where none of the patients had elevated LDLC only above targeted goal. There was no significant correlation between the anthropometric indices and the lipid profile. This result is different from the result obtained by Kayode et al. [32]. This difference may be explained by different ethnicity, different nutritional status and level of urbanization between the two studies. Individuals with a similar BMI can vary considerably in their abdominal fat mass. Also its limitations are recognized by its dependency on race, with Asians having large percentages of body fat at low BMI values and it changes according to age. For these reasons, a measure of obesity that takes into account the increased risk of obesity related illnesses because of the accumulation of abdominal fat is desirable. There is a new tendency to use waist circumference or waist to height ratio rather than waist to hip ratio, because studies with computed tomography have disclosed them to closer relationship with intra-abdominal fat and with changes in intra-abdominal fat. The combination of WC and height that is W/Ht could manifest better in the morphology of an enlarged abdomen with inappropriate short stature. There is enough evidence in literature to support the beneficial effect of lowering of serum lipids in retarding macro-vascular disease. It is important to realize that hyperlipidaemia and the resultant macro vascular disease can develop even in the 'prediabetic phase' of Type 2 DM. Hence, early detection and correction of dyslipidaemic state is essential in the management of diabetic patients.

Conclusion

The study concludes that considering the NCEP-ATPIII dyslipidemia was prevalent among the T2DM subjects. About 40.74% of the subjects had lipid value outside of the target value, with the most frequent combination being ↑TC+↑LDLc. Reduced level of HDL was the most frequent lipid abnormality. LDL-C and TG being the most frequent lipid abnormality among diabetes patients. There was no significant correlations between the anthropometric indices and the lipid profile. The study also revealed that dyslipidaemia was found common irrespective of sex and socio-demographic characteristics. A prospective cohort study may be undertaken to elucidate the abnormal level (cut-off) of lipid fractions that affects T2DM to develop complications.

Competing Interests

The authors declare that they have no conflicts of interest.

Authors' Contributions

CBT, NM, and SFL conceived the study, SFL and MEA carried out sample analysis and data collection, SFL and MEA participated in analysis of the samples, data management and statistics, PAP, MM and MNR supervised the field study, LSF, MN and EWC drafted the manuscript. All authors reviewed the manuscript and approved the final version prior to submission.

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